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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER	
MALDONADO, JULIO J	

ART UNIT	PAPER NUMBER
2823	

DATE MAILED: 04/06/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/658,193	NIUYA ET AL.	
	Examiner	Art Unit	
	Julio J. Maldonado	2823	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *07 January 2004*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *11-16 and 20-25* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *14,20,21,24 and 25* is/are rejected.

7)☒ Claim(s) *11-13,15,16,22 and 23* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

1. The rejection of claims 11-16, 20 and 21 in paper mailed on 10/09/2003 is withdrawn in view of applicants' amendments filed on 01/07/2004.

2. The addition of claims 22-25 is acknowledged.

3. A new rejection is included in the present action.

4. Claims 1-16 and 20-25 are pending in the application.

Claim Objections

5. Claim 11 is objected to because of the following informalities: where claim 11 recites "...the second concavity the upper..." should recite --the second concavity and the upper--. Appropriate correction is required.

Claim Rejections - 35 USC § 112

6. The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

7. Claims 22 and 23 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. Claim 22 recites, "...wherein the protective film is not substantially formed on the upper surface of the first insulating film..." and claim 23 recites, "...wherein the protective film is not formed on the barrier layer...".

However, it is noted on page 6, lines 19 – 21 that the protective film is formed not only on the surface of the metal layer, on he barrier layer and on the insulating layer.

8. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

9. Claim 14 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Claim 14, recites, "...applying a solution of a compound onto the surface of the device so as to form a protective film for preventing metal diffusion on a surface of the first metal layer for preventing metal diffusion...". This renders the claim indefinite since it was already specified that the protective film prevent metal diffusion, thus failing to further limit the claim.

Claim Rejections - 35 USC § 103

10. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

11. Claims 14, 20, 24 and 25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Yin et al. (U.S. 6,150,257) in view of Matsuda et al. (U.S. 6,150,270), Endo et al. (U.S. 5,795,828) and Cheung et al. (U.S. 6,153,521).

In reference to claims 14, 20, 24 and 25, Yin et al. (Figs.2-5) in a related method for forming an interconnect in a semiconductor device teach forming a first insulating film (14) on the device; forming a first concavity (26) in the first insulating film (14);

forming a barrier layer (28, 30) on the concavity and the insulating film (14); burying a metal film on the concavity (26); polishing the metal film and the barrier layer (28, 30) to form a metal layer (12) in the concavity (26); forming a protective film (32) over the surface of the metal layer (12), wherein the protective film (32) is selectively deposited on the surface of the metal layer (12) and not on the surface of the barrier layer (28, 30) nor on the surface of the insulating film (14); forming a second insulating film (18) on the surface of the device, wherein the second insulating film (18) is in contact with the surface of the first insulating film (14) and the surface of the protective film (32); forming a second concavity (34) in the second insulating film (18); and removing the protective film (32), wherein said forming second concavity step can be used to form a second interconnect (column 5, line 37 – column 9, line 15).

Yin et al. fail to teach forming the protective film applying a solution of a compound onto the surface of the device so as to form said protective film; and wherein the metal used to form the metal layer comprises copper. However, Matsuda et al. (Figs.3 and Figs.5A-8C), as part of the conventional methods within the art to form interconnects in a semiconductor device teach making a concavity in a insulating film (12) of the device; covering an inside surface of the concavity and an upper surface of the insulating film (12) with a barrier layer (13) for preventing metal diffusion; burying the concavity covered with the barrier with a low-resistance wiring metal comprising copper; polishing the buried metal to remove a part of the wiring metal residing higher than a level of the upper surface of the insulating film (12) so as to leave a metal layer (14) in the first concavity; applying a solution of a metal chloride onto the surface of the device

so as to form a protective film (71) for preventing metal diffusion on a surface of the metal layer (14), wherein the protective film (71) comprises a metal selectively deposited by electroless plating on the surface of the metal layer (14) and not on the surface of the barrier layer nor the surface of the insulating film (12) (column 1, line 53 – column 2, line 10 and column 4,line 30 – column 6, line 53).

It would have been within the scope of one of ordinary skill in the art to combine the teachings of Yin et al. and Matsuda et al. to enable the formation of the protective film step of Yin et al. to be performed according to the teachings of Matsuda et al. because one of ordinary skill in the art at the time the invention was made would have been motivated to look to alternative suitable methods of performing the disclosed formation of the protective film of Yin et al. and art recognized suitability for an intended purpose has been recognized to be motivation to combine. MPEP 2144.07.

The combined teachings of Yin et al. and Matsuda et al. fail to teach wherein the compound is stannous chloride, stannous borofluoride, stannous sulfate, nickel sulfate, nickel chloride, or nickel sulfaminate. However, Endo et al. in a related method to form damascene teach forming a metal layer using stannous chloride, stannous borofluoride, stannous sulfate, nickel chloride, or nickel sulfaminate by electroless plating (column 4, lines 43-49). Therefore, it would have been obvious to one of ordinary skill in the art to use the nickel chloride as taught by Endo et al. in the embodiment Yin et al. and Matsuda et al., since nickel chloride is well-known material used for the deposition of metallic nickel by electroless plating (column 4, lines 20-56).

The combined teachings of Matsuda et al. and Endo et al. fail to teach forming a second insulating film on the surface of the device, the second insulating film contacting the upper surface of the first insulating film from which the first barrier layer is removed, the second insulating film contacting the protective film, making a second concavity in the second insulating film with a second barrier layer; and burying the second concavity with the second barrier layer with a second wiring metal layer. However, Yin et al. (Figs.2-5) in a related method for forming an interconnect in a semiconductor device teach forming a first insulating film (14) on the device; forming a first concavity (26) in the first insulating film (14); forming a barrier layer (28, 30) on the concavity and the insulating film (14); burying a metal film on the concavity (26); polishing the metal film and the barrier layer (28, 30) to form a metal layer (12) in the concavity (26); forming a protective film (32) over the surface of the metal layer (12), wherein the protective film (32) is selectively deposited on the surface of the metal layer (12) and not on the surface of the barrier layer (28, 30) nor on the surface of the insulating film (14); forming a second insulating film (18) on the surface of the device, wherein the second insulating film (18) is in contact with the surface of the first insulating film (14) and the surface of the protective film (32); forming a second concavity (34) in the second insulating film (18); and removing the protective film (32), wherein said forming second concavity step can be used to form a second interconnect (column 5, line 37 – column 9, line 15).

Still the combined teachings of Yin et al., Matsuda et al. and Endo et al. fail to teach making the second concavity simultaneously in the second insulating film and the protective film. However, Cheung et al. (Figs.1-5) in a related method to form

interconnects teach forming a concavity in a multiple dielectric stack (32, 34, 36) using a single etching step, and selecting the etchants depending on the materials used to form the multiple dielectric stack (32, 34, 36) to perform said single etching step (column 4, lines 41 – 56). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to combine the teachings of Obeng et al and Asai et al. with the teachings of Cheung et al. to enable performing a single etching step as taught by Cheung et al. in the interconnect formation process of Obeng et al. and Asai et al.

12. Claim 24 is rejected under 35 U.S.C. 103(a) as being unpatentable over Yin et al. ('257) in view of Matsuda et al. ('270), Endo et al. ('828) and Cheung et al. ('521) as applied to claims 14, 20, 24 and 25 above, and further in view of Obeng et al. (U.S. 6,323,131 B1).

The combined teachings of Yin et al., Matsuda et al., Endo et al. and Cheung et al. substantially teach all aspects of the invention including cleaning the surface of the device after the polishing step to eliminate particles therefrom (Yin et al., column 7, lines 26 – 31) but fail to disclose wherein said cleaning comprises washing the device. However, Obeng et al. (Figs.1a-d) in a related method to form interconnects in a semiconductor device teach forming an insulating film (10) on a semiconductor device; forming a concavity (16) in the insulating film (10); forming a barrier layer (18) followed by forming a metal layer (20) within the concavity (16); polishing the metal layer (20) and the barrier layer (18); and cleaning the surface of the device after performing said polishing step, wherein said cleaning comprises washing the device (column 3, lines 23

– 51). It would have been within the scope of one of ordinary skill in the art to combine the teachings of Yin et al., Matsuda et al., Endo et al. and Cheung et al. with Obeng et al. to enable the cleaning step of Yin et al., Matsuda et al., Endo et al. and Cheung et al. to be performed according to the teachings of Obeng et al. because one of ordinary skill in the art at the time the invention was made would have been motivated to look to alternative suitable methods of performing the disclosed cleaning step of Yin et al., Matsuda et al., Endo et al. and Cheung et al. and art recognized suitability for an intended purpose has been recognized to be motivation to combine. MPEP 2144.07.

Allowable Subject Matter

13. Claims 11-13, 15, 16, 22 and 23 would be allowable if rewritten to overcome the rejection(s) under 35 U.S.C. 112, first paragraph, set forth in this Office action and to include all of the limitations of the base claim and any intervening claims.

14. The following is a statement of reasons for the indication of allowable subject matter: the prior art of record fail to teach applying a solution of an organic substance to the device so as to form a protective film of the organic substance on a surface of the first metal layer for preventing metal diffusion; and forming a second insulating film on the surface of the device, wherein the second insulating film is contacting the upper surface of the first insulating film from which the first barrier layer is removed, the second insulating film contacting the protective film.

Response to Arguments

15. Applicant's arguments with respect to claims 14, 20, 21, 24 and 25 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

16. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

17. Any inquiry of a general nature or relating to the status of this application should be directed to the Group Receptionist whose telephone number is 571-272-2800. See MPEP 203.08.

18. Any inquiry concerning this communication or earlier communications from the examiner should be directed to examiner Julio J. Maldonado whose telephone number is (571) 272-1864. The examiner can normally be reached on Monday through Friday.

19. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudhuri, can be reached on (571) 272-1855. The fax number for this group is 703-872-9306 for before final submissions, 703-872-9306 for after final

submissions and the customer service number for group 2800 is (703) 306-3329.

Updates can be found at http://www.uspto.gov/web/info/2800.htm.

Julio J. Maldonado
Patent Examiner
Art Unit 2823

Julio J. Maldonado
April 2, 2004

George Fourson
Primary Examiner